

The Cognitive, Behavioral, and Personality Profiles of a Male Monozygotic Triplet Set Discordant for Sexual Orientation

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The neurohormonal theory of sexual orientation proposes that homosexual men and homosexual women are exposed prenatally to a hormonal environment that is similar to that of the other sex. Prenatal exposure to an opposite-sex hormonal environment may lead the nervous system to develop in a manner consistent with the opposite sex. If this cross-sex exposure occurs, one prediction would be that the cognitive ability profile of homosexual men would be similar to that of heterosexual women. This study examined a set of male monozygotic triplets, aged 21 years, discordant for sexual orientation: 2 of the triplets were heterosexual, 1 was homosexual. The triplets were administered measures of 23 domains of cognitive ability, as well as measures of sexual orientation and masculinity/femininity. On the measures of cognitive ability, the triplets performed similarly, yet consistent differences were found between the 2 heterosexual triplets and the 1 homosexual cotriple. Differences having the same pattern were found for the number of Schafer homosexuality signs on the Rorschach, and on a homosexuality scale derived from items on the Minnesota Multiphasic Personality Inventory—2 (MMPI-2). Responses from the homosexual triplet were in a more feminine direction than responses from his 2 heterosexual cotriplets on measures of masculinity–femininity, which included measures derived from Rorschach responses, the MMPI-2 Masculinity–Femininity scale, the Bem Sex Role Inventory, and the Boyhood Gender Conformity Scale. Responses to the 16 Personality Factor Questionnaire also distinguished the 1 homosexual triplet from the 2 heterosexual cotriplets. These findings support the view that the prenatal hormonal environment may have enduring effects on selected behavioral traits.

KEY WORDS: sexual orientation; cognitive ability; behavioral genetics; triplets.

INTRODUCTION

Few would dispute the importance of sexual orientation in persons' lives and, in recognition of this, researchers have actively sought its origins during the last two decades. Much of this work has focused on how biological mechanisms influence sexual orientation development, the results of which suggest that genes, brain anatomy, and prenatal sex hormones influence sexual

orientation in men (Hershberger, 2001). Researchers have used two broad approaches to the biological origins of sexual orientation: neurohormonal and genetic. In one way or another, all biological approaches to the origins of sexual orientation encompass either one of these views.

Neurohormonal Etiology

A neurohormonal etiology is based on the reasoning that sexual orientation depends on the early sexual differentiation of hypothalamic brain structures. The differentiation of these brain structures, in turn, depends on prenatal androgen. Masculinization of brain structures occurs because of relatively high levels of androgens, whereas feminization of brain structures occurs in the absence of sufficient levels of androgens. These differences led to the

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idea that homosexual men and heterosexual women have neural sexual orientation centers that are similar to each other and different from those of heterosexual men and homosexual women.

The results of two different avenues of investigation strongly support this idea. In the first, studies have been conducted examining the effects of prenatal patterns of sex steroid secretion on the development of sexually dimorphic behaviors in nonhuman animals. Animals who have had their prenatal hormonal environments experimentally altered to mimic the hormonal environment of the opposite sex frequently exhibit postnatal sexual behaviors characteristic of the opposite sex (see Breedlove, 1994, for a review). For example, male rats who have experienced prenatal androgen-deficient hormonal environments exhibit lordosis, lack of aggressiveness, and avoid rough-and-tumble play. Conversely, female rats who have experienced unusually high levels of androgen exhibit mounting behavior, increased levels of aggression, and avoidance of maternal rearing behavior.

A second line of neurohormonal research studies humans whose prenatal sex steroid environment has been atypical because of a physical disorder. The most frequently studied condition arising from an atypical prenatal hormonal environment has been congenital adrenal hyperplasia (CAH), an inherited, autosomal recessive disorder of adrenal steroidogenesis. CAH causes excessive production of adrenal androgens; in female newborns, this results in full or partially masculinized external genitalia, whereas in male newborns, it appears to have little or no apparent effect. CAH females exhibit unusually high levels of masculine-type behavior, including "masculine" toy preferences, high rates of masculine gender identity, elevated rates of homosexual fantasy and behavior, and low marital rates (Meyer-Bahlburg, 2001).

Genetic Etiology

Genetic differences among individuals could also trigger differences in sexual orientation, perhaps by inducing differences in prenatal androgen levels or sensitivity to androgen. Behavior genetic studies, primarily using twins, have been the most productive methods of exploring genetic influence on sexual orientation and behavior. Twin studies generally compare resemblance between monozygotic (MZ) and dizygotic (DZ) twins (Segal, 2000). To date, there have been nearly a dozen large studies comparing the concordance rates of MZ and DZ twins for homosexuality. These studies generally converge on the conclusion that sexual orientation is significantly

influenced by genetic factors in men, but less so in women (Hershberger, 2001).

Twin studies are, however, vulnerable to some design problems that could compromise the interpretation of their results. For example, concordant-dependent ascertainment, in which there is a greater likelihood of MZ twins concordant for sexual orientation volunteering than those MZ twins who are discordant may occur. There is also a greater likelihood in general of MZ twins volunteering than DZ twins (Neale, Eaves, & Kendler, 1989). Moreover, there are at least three problems to which twin studies of sexual orientation are particularly susceptible. First, the representativeness of the samples are open to question, because many of the studies obtain participants through homophile publications, which may not have a readership reflective of the general homosexual population (e.g., Whitam, Diamond, & Martin, 1993). Second, how *sexual orientation* is defined affects the magnitude of the computed heritability (e.g., Hershberger, 1997). Third, certain analytic approaches to estimating heritability require knowledge of the population base rate of homosexual orientation (e.g., Bailey & Pillard, 1991). Perhaps the strongest studies of genetic influence on sexual orientation use large population-based strategies for obtaining twins (e.g., twin registries; Kirk, Bailey, & Martin, 2000). Importantly, population-based studies report heritability estimates of sexual orientation significantly lower than studies that rely on advertising or word of mouth to obtain participants.

Sexual Orientation and Cognitive Ability

Finding that biology plays a significant role in sexual orientation is of considerable consequence for the emergence of cognitive differences between homosexual and heterosexual men. If a hormonal explanation of sexual orientation is correct, we would expect the cognitive attributes of male homosexuals to be feminized, more closely resembling heterosexual females than heterosexual males. Sex differences should, in this case, generalize to sexual orientation differences.

The most dramatic sex difference in cognitive ability is found on measures of spatial ability, in particular tests of mental rotation, with males typically outperforming females (Linn & Petersen, 1985; Voyer, Voyer, & Bryden, 1995). To a lesser extent, men also perform better on measures of spatial perception, such as the water-level test, which asks participants to predict the appearance of the water level in containers that are presented in various orientations. However, negligible sex differences are found on tests of spatial visualization (e.g., the Block

Design subtest of the Wechsler Adult Intelligence Scale), a third type of spatial ability test (Voyer et al., 1995). Males also tend to outperform women on tests of mathematical reasoning ability (Becker & Hedges, 1984). In contrast, evidence exists for female superiority on tests of verbal fluency, an example of which is to name as many words as one can that begin with the letter "F" during a brief period of time (Halpern, & LaMay, 2000). Females are also found to outperform men on tests requiring rapid visual scanning and matching, as well as on tests of location memory (Halpern & Crothers, 1997).

Evidence suggests that sex differences in cognitive abilities are prenatal in origin. According to one theory, high levels of prenatal testosterone slow the development of the left hemisphere in men, resulting in hemispheric lateralization for many cognitive tasks. In men, language functions are mediated by the left hemisphere, whereas spatial functions are mediated by the right hemisphere; however, hemispheric lateralization is less strong in women, as evidenced by the presence of language functions in the right hemisphere (McGlone, 1980). The presence of language functions in the right hemisphere appears to interfere with information processes in women (thus accounting for their relatively poorer performance), but at the same time improves their processing of linguistic information. Women can call upon either their right or left hemisphere for interpreting linguistic information.

If prenatal hormonal effects on CNS development can be used to explain sex differences in cognitive ability, then they can also be used to explain the origin of differences in cognitive abilities between homosexual and heterosexual men. For example, Willmott and Brierley (1984) found that although there were no overall IQ differences between heterosexuals and homosexuals, homosexual males had higher verbal IQs than did heterosexual males and females. A similar result was obtained by Tuttle and Pillard (1991), who found that homosexual males had higher vocabulary scores on the Wechsler Adult Intelligence Scale than did heterosexual males. McCormick and Witelson (1991) found that homosexual males had greater verbal fluency than did heterosexual males, but neither male group was as fluent as heterosexual females. On a computerized lexical-decision-making task, heterosexual women and homosexual men performed comparably, and superior, to heterosexual men (Wegesin, 1998). Rahman, Abrahams, and Wilson (2003) also showed that homosexual men outperformed heterosexual men on synonym, category, and letter fluency tests.

Studies of spatial abilities show even more consistent results, with several investigators reporting that heterosexual males outperformed homosexual males and heterosexual females (e.g., Cohen, 2002; Gladue, Beatty,

Larson, & Stratton, 1990; Rahman & Wilson, 2003; Sanders & Ross-Field, 1986; Tuttle & Pillard, 1991; Wegesin, 1998; Willmott & Brierley, 1984). A number of studies have also found that homosexual men score higher on the intellectual and openness to change factors (factors B and Q₁, respectively) of the 16 Personality Factor Questionnaire (16PF), both of which are significantly correlated with general intelligence measures (see Duckitt & du Toit, 1990).

Other Sexual Orientation Differences

Sexual orientation differences have also been found on gender conformity, somatic measures, and voice and speech characteristics. The greater recalled gender atypicality of homosexual men is one of the most robust findings in sexual orientation research (Bailey & Zucker, 1995). If hormones influence the development of sex dimorphic behavior and sexual orientation, an atypical gender identity would be expected among homosexual males. Somatic measures show sexual orientation differences consistent with hormonal influences; for example, homosexual men tend to weigh less than heterosexual men (e.g., Bogaert & Blanchard, 1996).

Somatic differences are also found for the hands: Homosexual men have elevated rates of non-right-handedness (Lalumière, Blanchard, & Zucker, 2000) and more dermal ridges on the left hand (Green & Young, 2000). Voice and speech differences between homosexual and heterosexual men are also consistent with sex differences. For examples, a higher pitch is usually associated with feminine speech (Bachorowski & Owren, 1999); homosexual males are perceived to have higher pitched voices than heterosexual males (Gaudio, 1994).

This Study

The primary purpose of this study was to explore differences between the cognitive ability profiles of homosexual and heterosexual males. In addition, comparisons were conducted on somatic measures, measures of voice and speech, and masculinity–femininity, all of which were expected to show male sexual orientation differences.

A unique approach to testing cognitive ability differences between homosexual and heterosexual men presented itself when the first author was on the faculty of a large, Midwestern university. A set of triplets, three brothers, who were attending the university, learned of the author's interest in biological influences on sexual orientation and introduced themselves to him. The brothers

were 21 years of age. Even with the increase in multiple births caused by assisted reproductive technology, MZ triplets are still relatively rare, representing 1 in 50,000 births (Reynolds, Schieve, Martin, Jeng, & Macaluso, 2003). In general, triplets have been invaluable sources of information about the effects of heredity on human behavior, but these triplets had two especially noteworthy attributes: (1) they were monozygotic and (2) they were discordant for sexual orientation. One brother (henceforth to be referred to as HM) identified himself as homosexual, whereas the other two brothers (henceforth to be referred to as HT1 and HT2) identified themselves as heterosexual.

Clearly, if cognitive abilities differ between homosexual and heterosexual men, one would predict that HM's performance across a series of tests of cognitive abilities would exhibit a pattern different from those of HT1 and HT2. This represented a strong test of the hypothesis, for one would expect that the triplets' monozygosity would diminish these differences. All three agreed to participate in a study examining this hypothesis, but were unaware of specific predictions.

METHOD

Participants

It was instructive to examine the triplets' personal perspectives on developmental issues relevant to their discordant sexual orientation. The second author acquired this material during telephone interviews conducted separately with each triplet as part of an ongoing book project. The triplets, who were naturally conceived, were born on July 18, 1975, making them 21 years of age at the time of the interviews. They were delivered vaginally in a vortex position and born 3 and 4 min apart. Their birth occurred 6.5 weeks prematurely, requiring incubation of all three infants in a high-risk nursery. They were healthy but, given the lung difficulties associated with premature births, it became critical to monitor their early breathing; however, breathing problems never developed.

The family was Caucasian and middle class. The mother was 30 years of age and the father was 35 years of age at the time of their birth. The parents already had an older son who was 20 months of age at the time. Having triplets was regarded as a positive experience by their mother and father. The infants were color coded in blue (HT1), red (HM), and green (HT2), with respect to birth order, to tell them apart. Their birth weights were 4 lb, 1 oz; 3 lb, 14 oz; and 4 lb, 0 oz, respectively. They arrived home individually, HM at 9 days, HT1 at 5 days, and HT2 at 7 days so as not to overwhelm their older brother. They developed no remarkable illnesses or allergies, although

colds and stomach flu occurred frequently. They were not nursed, but were administered a variety of formulas with medications to relieve their colic that persisted for 6 months. They began sleeping regularly at approximately 8 months of age.

Two sources of information were instructive: (1) home videotapes made of the triplets as young children and (2) HM's recollections of childhood perceptions and feelings. "It's all clearer looking back," he remarked. In the films, HM's mannerisms and reactions were perceived by family members as strikingly different from those of his two brothers. In fact, their mother referred to him as her "sensitive, artistic one." His cotriplets were known as the "stubborn one" and the "athletic one." Other commonly used descriptive terms were "delicate," "willful," and "cocky," respectively. There was a scene in one video in which one triplet (then age 6) is boxing with his older brother, leaving HM and HT1 to spar with one another; however, HM was crying because he did not want to participate.

When HM was "little," he recalled being at a ball game and visiting the restrooms at the stadium. There he experienced a fascination with the opportunity to inspect the variety of male genitalia. He was aware that many children "like to look," but his remembrance of this experience was extremely "vivid." It was a feeling that has not abated. At age 17, he became fixated on a high school teacher much older than he. During his high school years, HM coped, in part, by "hiding behind" his two brothers. When HM directly revealed his sexual preference to his brothers in college, it did not completely surprise them.

Following high school graduation, the triplets attended the same university away from home where they variously roomed together and apart during the next 4 years. HM majored in theater and psychology, HT1 majored in journalism, and HT2 majored in education and health. Their occupations at the time of the interview were hospital consultant, project coordinator for telecommunications, and medical supplier, respectively. HM was currently living at home and making plans to move out on his own. HT1 was married, and HT2 was unmarried and living out of state.

The triplets' differing sexual orientations have not impaired the strong social bonds they have always felt for one another. In this respect, they resembled the majority of other MZ twins and triplets for whom the social relationship is profound and enduring (see Segal, 2000). All believed they were treated equally and fairly by both parents.

Before commencing the study, the monozygosity of the triplets was confirmed through four sources of information, ordered here from weakest to strongest:

(1) the parents of the triplets were certain of their sons' zygosity, having been informed of this by the attending physician; (2) responses to a standard zygosity questionnaire, which included items about adult height, weight, eye color, hair texture, and hair curliness; whether strangers, friends, or family members confused them; and whether they were as "similar as two peas in a pod"; (3) the mother's report that the triplets shared the same placenta; and (4) blood samples that were typed for 18 polymorphic markers.

Over the course of a semester, a number of cognitive ability, personality, and biographical measures were administered to the triplets. The triplets also underwent audiometric, anthropometric, and speech and voice measurement in various laboratories at the university. These assessments were completed by trained individuals blind to the triplets' zygosity and sexual orientation status. One projective test of personality and psychological functioning, the Rorschach, was administered by a trained clinical psychologist, who was also blind to the triplets' zygosity and sexual orientation status. The first author and a clinical psychologist, different from the one who administered the test, scored the Rorschach.

The first author obtained Institutional Review Board approval from his university where the data were collected. Informed consent was obtained from the triplets prior to the beginning of the study. Permission was also obtained from the triplets to submit a final report of the study's results for publication. Before its submission, the triplets reviewed the present report of the study and approved its contents.

Measures

The measures used in this report are listed in Table I.

Sexual Orientation and Behavior

To more confidently label the triplets as either "homosexual" or "heterosexual," a sexual orientation and behavior questionnaire was administered. This questionnaire consisted of items that asked respondents to identify their sexual orientation, to describe their sexual fantasies and behaviors involving partners of both sexes from 12 to 18 and from 19 to 21 years of age, to reveal the number of lifetime sexual partners of both sexes, and indicate the age at which their sexual orientation was revealed to others if they ever did so.

Rorschach HS (Schafer Homosexuality Signs). Schafer (1954) proposed a set of nine signs of male homosexual orientation. These signs are as follows: (1) reversal, combining, blurring, and arbitrary assignment of sex characteristics; (2) feminine emphasis; (3) reference to perversions; (4) hostile, fearful conception of masculine role; (5) hostile, fearful, rejecting characteristics of women; (6) preoccupation with feminine bodies and pleasures; (7) anal perspective and preoccupation; (8) castration emphasis; and (9) general increase in sexual imagery. The percentage of total responses (*R*) that are Schafer signs (*HS%*) can be used as an indicator of male homosexual orientation. Schafer signs have been shown to successfully differentiate male homosexuals from male heterosexuals (Andersen & Seitz, 1969; Hooker, 1958; Raychaudhuri & Mukerji, 1971; Seitz, Andersen, & Braucht, 1974).

The Minnesota Multiphasic Personality Inventory—2: Homosexuality Scale. Panton (1960) proposed a homosexuality scale (*HSX*), on the basis of his finding that 22 items from the original version of *MMPI* significantly distinguished homosexual from heterosexual men. Subsequent studies also found that the *HSX* scale distinguished homosexual and heterosexual men (Krippner, 1964; Pierce, 1972). In *MMPI-2*, 17 of the 22 items

Table I. Study Measures

Category	Measure
Sexual orientation and behavior	Self-identification; fantasies; number of sex partners; sexual orientation disclosure; Rorschach Schafer homosexuality signs; Minnesota Multiphasic Personality Inventory—2: Homosexuality Scale; 16 Personality Factor Questionnaire
Anthropometric	Height, weight, and shoe size; Nose and head: height, breadth, and length; Handedness; Fingerprint ridge count
Speech and voice	Fundamental frequency; Formant frequencies; Speech rate; Total, vowel, and word duration
Masculinity/femininity	Rorschach: human movement responses, femininity, barrier responses, and penetration responses; Bem Sex Role Inventory; Boyhood Gender Conformity Scale; Minnesota Multiphasic Personality Inventory—2: Masculinity–Femininity Scale
Cognitive	Rorschach: response productivity and intellectual functioning; Water-level task; Vandenburg and Kuse Mental Rotation Test; Shipley–Hartford Vocabulary Test; Educational Testing Service Kit of Factor-Referenced Cognitive Tests

remained, which permitted the creation of an HSX score for each of the triplets.

Sixteen Personality Factor Questionnaire (16PF). Sixteen primary factors and five global personality factors are measured by 16PF (Cattell, Eber, & Tatsuoka, 1988). Of particular interest were three scales that differed significantly between men and women in the normative sample: warmth, dominance, and sensitivity. Thus, one hypothesis might be that heterosexual and homosexual men differ significantly on these three scales as well; however, it turns out that differences between heterosexual and homosexual men have been better represented by profile differences across all 16 personality factors (Bernard & Epstein, 1978).

Anthropometric

A series of anthropometric measurements was obtained, including detailed measures of head and facial dimensions and fingerprints. A graduate student in physical anthropology made these measurements, blind to the zygosity and sexual orientation of the triplets. A colleague, Dr Lynn Hall, an expert on dermatoglyphics who has published studies on finger ridge patterns and sexual orientation (e.g., Hall, 2000), measured the fingerprint ridge count on both the left and the right hands of the triplets. She was also unaware of their zygosity and sexual orientation.

Speech and Voice

Audio recordings were made of the triplets reading the first section of the Rainbow Passage (Fairbanks, 1960), counting to 20, and reading lists of words containing the four vowels, /a/, /i/, /u/, /ae/; the three syllabi, /pa/, /ta/, /ka/; and the three words, /kait/, /piknik/, and /dag/. From these recordings, several speech and voice measures were extracted for each of the triplets using the Computerized Speech Lab-Model 4300B and the DSP Sona-Graph, both manufactured by Kay Elemetrics.

Fundamental Frequency. Fundamental frequency (FO) is the vibratory rate of the vocal cords, as measured in hertz (Hz), and is synonymous to the more common term, pitch. FFO is a function of the length and density of the vocal cords, as well as the amount of stress placed on them during speech. This measurement reflects the "physiological limits" (strength) of the voice. For adult men the average FO is 125 Hz during normal conversation, whereas for adult women the average is 215 Hz (Colton & Casper, 1996). The sex difference for fundamental frequency, which occurs for several other

speech measures, has been primarily attributable to the shorter (by 15%) vocal cords of adult women.

Formant Frequencies. Each vowel sound has several characteristic amplitude peaks (measured in Hz), two of which are first formant (F1) and second formant (F2). F1 has the lowest frequency peak and F2 the second lowest. The frequencies at which formants occur depend on the length of the vocal cords, the tongue position, and the height of the tongue. Different vowels have been distinguished by different formant frequencies. For neutral vowels, the average value of F1 has been 500 Hz in adult men, whereas the average value for F2 has been 1,500 Hz. For adult women, the values have been 600 and 1,800 Hz, respectively (Pickett, 1999).

Speech Rate. The number of syllables produced in 1 s (syllables/seconds) is referred to as the speech rate. Women have typically shown higher speech rates than have men (Feldstein, Dohm, & Crown, 1993; Nicholson & Kimura, 1996; Wu & Childers, 1991).

Total Duration. Total duration is the total amount of time (in second) to produce one syllable, including respiration and pauses.

Vowel Duration. Vowel duration is the length of time (in millisecond) to produce one vowel, less the time spent on respiration and pauses.

Word Duration. Word duration is the length of time (in millisecond) to produce one word, syllable, or number, less the time spent on respiration and pauses.

Men have typically shown longer total, vowel, and word duration times than women (Avery & Liss, 1996).

Because significant sex differences have been found for all of the above measures of speech and voice, sexual orientation differences were predicted as well.

Masculinity–Femininity

Rorschach M (Human Movement Responses). Rorschach *M* scores are a count of human movement responses. A response is scored as a human movement response if it is characterized by one of the following: (1) human-like action attributed to a portion of a figure; (2) animals in human-like action; (3) caricature and statues in human-like action; (4) human facial expressions; and (5) human-like facial expressions in animals.

Rorschach M% (Femininity). Evidence exists that the percentage of human movement responses (using *R* as a base) can be interpreted as a measure of femininity. Coursol (1996), Kleinman and Higgins (1966), and Raychaudhuri and Rabindra (1971) found that *M%* was significantly higher in adult females than in adult males. Additionally, Raychaudhuri and Rabindra (1971)

reported that $M\%$ predicted femininity in adult males. Results reported by Benveniste (1995) and Voigt (1966) indicated interrater reliability for scoring responses as human movement.

Rorschach B (Barrier Responses). Barrier responses are those attributable to concern for the vulnerability of the human body, and more broadly, interest in erecting barriers between the respondent and the outer world. A response was characterized as a barrier response if it included at least one of the following: (1) animals wearing clothing; (2) humans wearing unusual clothing; (3) reference to the skin of an animal; (4) enclosed openings in the earth (e.g., wells); (5) animals used as containers (e.g., milk in cow udders); (6) overhanging or protective surfaces (e.g., umbrellas); (7) armored objects; (8) covered, surrounded, or concealed objects, people or animals; (9) objects with container-like properties or shapes (e.g., chairs); (10) vehicles; and (11) buildings. Most studies have reported interrater reliabilities for barrier responses above .90 (e.g., Fisher & Cleveland, 1958).

Rorschach P (Penetration Responses). Penetration responses include references to penetrating boundaries. A response was characterized as a penetration response if it included at least one of the following: (1) open human or animal mouths; (2) penetrating objects; (3) injured or degenerated objects, people, or animals; (4) boundary-less openings (e.g., a bottomless lake); (5) transparent objects; and (6) all other types of openings (e.g., the anus). As in the case of barrier responses, penetration responses have also been reliably identified by different raters (e.g., Fisher & Cleveland, 1968).

$\frac{B-P}{B+P} \times 100$ (*Femininity*). Several researchers have found that women obtain significantly higher barrier scores than do men and that men obtain significantly higher penetration scores than do women (e.g., Fisher, 1964; Fisher & Cleveland, 1968; Hartley, 1967). Thus, a comparison between barrier and penetrations scores might provide some indication as to the “femininity” of the respondent.

Bem Sex Role Inventory. The Bem Sex Role Inventory (BSRI; Bem, 1974) is a 60-item measure of masculinity, femininity, and androgyny, in which respondents rank each item as to how well the adjective describes them. Twenty of the items are stereotypically feminine, 20 are stereotypically masculine, and 20 are gender neutral. The masculinity items can also be interpreted as measuring “instrumentality”; the femininity items can be interpreted as measuring “expressiveness” (Lippa, 2002). Items are scored from 1 (*never or almost true*) to 7 (*always or almost always true*). Bem reported Cronbach’s alpha reliabilities of .80–.86 for femininity and masculinity,

respectively. Comparable alphas have been reported from other studies (e.g., Ballard-Reisch & Elton, 1992). The test–retest reliability of BSRI, over an 8-week period, has been .80 for femininity, .93 for masculinity, and .86 for androgyny (Rowland, 1977). Other studies have shown that BSRI correctly assigned individuals to their sex-role classification on the basis of external criteria (Myers & Finn, 1985).

The Boyhood Gender Conformity Scale. The Boyhood Gender Conformity Scale (BGCS; Hockenberry & Billingham, 1987) consists of 20 items constructed to classify adult male respondents for sexual orientation on the basis of their reported boyhood gender conformity or nonconforming behavior and identity. Each item is scored from 0 (*Never or almost never true*) to 6 (*Always or almost always true*). Ten of the items are “masculine,” and the other 10 are “feminine.” The 10 masculine items are reverse scored to be in the feminine direction so that higher scores represent higher levels of gender nonconformity. In BGCS, the mean of the 20 items for homosexual males was 2.96, and for heterosexual males, the mean was 1.80. The authors reported a test–retest reliability of .92 after a 2-week interval based on discriminant function scores obtained from a discriminant analysis of 13 of the scale’s items. Indicative of the scale’s validity, the discriminant analysis correctly classified homosexual and heterosexual respondents. Phillips and Over (1992) also found that BGCS significantly discriminated homosexual from heterosexual respondents. The average of the 20 BGCS items was reported for each triplet in this study.

The Minnesota Multiphasic Personality Inventory—2: Masculinity–Femininity Scale. The masculinity–femininity scale (Mf-m) is a 56-item scale derived from the 567 items of MMPI-2. According to the authors of MMPI, this scale measures respondents’ nonconformity to gender roles (including homoerotic sexual fantasies) and to several variables on which men and women differ (Hathaway & McKinley, 1989). The scale’s mean based on the normative sample is 26.01 ($SD = 5.08$).

Cognitive

Rorschach R (Response Productivity). R is the total number of responses given to the inkblots. Typically, more than one response is given to each inkblot. If response quality is adequate, R can be interpreted as a measure of general intelligence or creativity (Aronow & Reznikoff, 1976).

Rorschach A (Animal Content Responses). The Rorschach A is the total number of responses that include references to animals.

Rorschach 1-A% (Intellectual Functioning). This score, which is a function of the percent of the total number of responses (*R*) which are *A*, can be used as a measure of general intelligence (e.g., Klopfer, Ainsworth, Klopfer, & Holt). Ramzy and Pickard (1949) reported an interrater reliability of .99. As evidence of its validity as a measure of general intelligence, 1-A% correlates significantly with Raven's Progressive Matrices (Wysocki, 1957), the Wechsler Adult Intelligence Scale (Consalvi & Canter, 1957), and college performance (Rust & Ryan, 1953).

Water Level Task. The triplets completed a paper-and-pencil version of the water-level task (Wegesin, 1998). The triplets were first shown an outline drawing of a jar capped with a cork. The jar was resting cork-side up on a horizontal line that was identified as a "table." The triplets were told that the jar was half-full of water as indicated by the horizontal line (the "water" line) parallel to the table. The triplets were told that on the following pages the jar would be shown in various orientations and that they were to draw the water line as it should appear using a pencil and a straight-edge. The jar was depicted in eight different orientations (1, 2, 4, 5, 7, 8, 10, and 11 o'clock) arranged in a random sequence. Each item was scored as correct (if a triplet's line was within 4° of the horizontal); otherwise, it was incorrect.

Mental Rotation. The triplets were allowed a total of 6 min to complete the 20 items on the Mental Rotation Test (Vandenburg & Kuse, 1978). This test required participants to identify which of four stimuli can be produced by mentally rotating a target stimuli. Each test

item had two correct and two incorrect choices. On each item, participants received 2 points if they marked both correct choices and 1 point if they marked only one correct choice. All other responses received a score of 0 for the item.

Shipley-Hartford Vocabulary Test. The Shipley-Hartford Vocabulary Test is a paper-and-pencil test composed of a list of 40 target words. The correct synonym to each target word was selected from among a group of four words beside each target word.

The Educational Testing Service Kit of Factor-Referenced Cognitive Tests. All 72 tests of the ETS Kit of Factor-Referenced Cognitive Tests (Ekstrom, French, & Harman, 1976) were administered. These 72 tests were constructed to act as "marker" tests for 23 factors of cognitive ability. The psychometric characteristics of the Kit have been examined extensively (e.g., Ekstrom et al., 1976).

RESULTS

Each triplet was certain about his sexual orientation upon entering the study. This was confirmed by the sexual orientation results presented in Table II; however, several responses were of note. First, HM experienced a notable change in his Kinsey rating for sexual feelings and behavior between the period from 12 to 18 years of age (Kinsey 2) and from 19 to 21 years of age (Kinsey 6). This change represented a change of sexual feeling and not a

Table II. Measures of Sexual Orientation

Measure	HM	HT1	HT2
Sexual feelings and behavior: 12–18 years of age ^a	2	1	1
Sexual feelings and behavior: 19–21 years of age ^a	6	1	0
Sexual fantasies with male partner: 19–21 years of age (%)	98	8	5
Sexual fantasies with female partner: 19–21 years of age (%)	2	92	95
Number of lifetime male sexual partners	14	0	0
Number of lifetime female sexual partners	0	9	12
Desirability of having male sexual partners ^b	5	5	3
Desirability of having female sexual partners ^b	3	5	5
Current self-identified sexual orientation	Homosexual	Heterosexual	Heterosexual
Number of HW Rorschach responses	10	6	4
HW% of Rorschach responses	25.00	23.08	16.67
Number of HS (Schafer) Rorschach responses	30	13	8
HS% of Rorschach responses	50.00	38.46	29.17
MMPI-2 HSX	9/17	11/17	8/17

^a0 = Sexual feelings and activity only with females; 1 = Most sexual feelings and activity with females, but an occasional fantasy or contact with males; 2 = Most feelings and activity with females, but some definite fantasy or activity with males; 3 = Sexual feelings and/or activity about equally divided between males and females; 4 = Most sexual feelings and activity with males, but some definite sexual feelings/activities with females; 5 = Most sexual feelings and activity with males, but an occasional fantasy or contact with a female; 7 = Sexual feelings and activity with males only.

^b1 = Totally disgusting; 2 = Slightly unpleasant; 3 = Neutral; 4 = Somewhat sexually exciting; 5 = Very sexually exciting.

change of sexual behavior. Before the age of 19, HM had entertained the idea that he might possibly be bisexual on the basis of the partial heterosexual content of his fantasies and his desire to have female dating partners, but he now dismissed this possibility at the time of testing, fully endorsing an exclusive homosexual orientation. When the first author interviewed HM, he had the impression that HM's relationships with girlfriends were not substantively serious, not progressing beyond flirtation. HM first had sex with another male at 18 years of age; he has never had sex with a female. At 19 years, HM first defined himself as exclusively homosexual in feeling and behavior. It was interesting to note that although HM reported having sex with 14 different male partners, he had not had sex in the past year.

A second notable result reported in Table II was HT1's strong endorsement of the "desirability of having male sexual partners." This appeared anomalous, considering his Kinsey score of 1 for sexual feelings and behavior. When asked specifically whether he "had ever been sexually attracted to a man or boy," HT1 responded "not sure." HT1 has never had sex with another male, although he did report having had nine different female sexual partners, only one of which was during the past year. This single female partner, whom he eventually married at 24 years of age, was from a committed relationship. Thus, the reason as to why HT1 would report at 21 years of age that the idea of having sex with another male was "desirable," especially when in a committed relationship with a female, was unclear.

Another notable anomaly of HT1's scores in Table II is his high HSX score. As explained in the Discussion, this result is probably related to HT1's relatively high MMPI-2 masculinity-femininity score in Table V; it is very likely that HSX scores partly reflect gender nonconformity, perhaps as much as they reflect sexual orientation. Table II also reports Schafer homosexuality (HSX) scores for the triplets that are consistent with their self-identified sexual orientations: HM's score was the highest; HT1's and HT2's scores were considerably lower and more similar to each other's than either was to HM's score. The two raters who scored the Rorschach for Schafer signs differed by only four responses for HM, and by only two responses for HT1 and HT2; thus the two raters' scores were averaged.

Table III shows the anthropometric measurements. Given their monozygosity, it was not surprising that they showed little difference on most of the physical traits. The only exception was the difference between the right- and left-hand ridge counts. HT1's left-hand ridge count was much greater than that for his right hand, whereas for HM and HT2, the right-hand ridge count was greater, although disparity between the two hands was much less. Thus,

Table III. Anthropometric Measures

Measure	HM	HT1	HT2
Stature (cm)	170.1	172.1	171.5
Nose height (cm)	5.2	4.9	4.8
Nose breadth (cm)	3.4	3.5	3.4
Morphological facial height (cm)	12.2	12.1	12.1
Head height (cm)	25.1	25.1	24.4
Head length (cm)	20.3	20.5	20.2
Head breadth (cm)	14.7	15.1	14.8
Bizygomatic diameter (cm)	13.6	13.7	13.8
Bigonial breadth (cm)	10.4	10.4	10.6
Head horizontal circumference (cm)	23.5	23.7	23.5
Minimum frontal breadth (cm)	10.4	10.7	10.4
Weight (kg)	78.84	81.65	82.56
Shoe size (cm)	24.13	24.13	22.86
Handedness	Right	Left	Right
Finger ridge count—right hand	70	110	61
Finger ridge count—left hand	83	64	91

whereas the results for HT1 and HM were as predicted, the results for HT2 were not: In fact, HT2, who on most indicators was the most masculine of the triplets, had a ridge count disparity most consistent with the disparity of a homosexual male.

Table IV reports sexual orientation differences for the speech and voice measures. As predicted, with the exception of /a/, the fundamental frequency (FO) means indicated that HM spoke with a higher pitched (in a female direction) voice than did his brothers. For example, HM's mean oral reading frequency was 176.9 Hz, whereas HT1's and HT2's frequencies were 155.0 and 148.4 Hz, respectively. Also as predicted, HM had higher formant frequencies (again in the female direction) on a greater number of vowels than did his brothers. For instance, HM's F1 frequency for /a/ was 520 Hz, whereas HT1's and HT2's F1 frequencies were 500 and 460 Hz, respectively. However, there were a few exceptions reported in Table III: HM's F1 frequency was lower for /i/ than are both of his brothers' frequencies, is lower than HT2's frequency for F1 on /ae/, and is equal to at least one of his brothers' frequencies on F1 for /u/. On the other hand, there was little difference among the brothers for the speech rate of oral reading. Lastly, total duration, vowel duration, and word duration have been shown to be longer in women than in men. Consistent with these findings were the sexual orientation differences shown in Table IV, with HM mostly having longer duration times than HT1 and HT2.

The results from measures of masculinity-femininity are provided in Table V. Clearly, HM consistently obtained scores indicating a greater degree of femininity compared to his brothers. In addition, the brothers maintained a

Table IV. Measures of Speech and Voice

Measure	HM		HT1		HT2	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Fundamental frequencies (Hz)						
Oral reading	176.9	35.8	155.0	27.9	148.4	32.3
Count to 20	183.3	27.2	141.9	7.4	137.6	21.7
/a/	156.0	1.3	167.1	1.2	143.2	1.1
/i/	160.8	1.2	174.5	0.89	168.7	1.5
/u/	162.2	1.3	175.6	1.8	169.9	1.9
/ae/	163.3	1.0	175.6	1.5	168.3	1.0
Formant frequencies (Hz)						
/a/						
F1	520		500		460	
F2	1,240		1,120		1,280	
/i/						
F1	280		300		340	
F2	2,400		2,440		2,400	
/u/						
F1	340		360		340	
F2	980		880		920	
/ae/						
F1	620		480		660	
F2	980		880		920	
Speech rate (syllables/s)						
Oral reading	5.3		4.7		5.4	
Total duration (s)						
Oral reading	3.8		4.2		3.7	
Count to 20	19.6		14.5		16.3	
Vowel duration (ms)						
/a/	154.7		182.8		176.6	
/i/	167.2		176.6		129.7	
/u/	187.5		207.8		157.8	
/ae/	201.6		246.9		218.8	
Word duration (ms)						
Count to 20	584.4		528.1		450	
/kait/	537.5		337.5		346.9	
/piknik/	395.3		435.9		370.3	
/dag/	237.5		421.9		343.7	

consistent ordering for each measure: HM was most feminine, HT1 was in the middle, and HT2 was least feminine. As for the Schafer signs, the two raters were in substantial agreement in scoring the Rorschach for human movement, femininity, barrier, and penetration responses. At most, the two raters disagreed by three responses on any of the scores; in such cases, their two scores were averaged.

Fig. 1 plots the 16PF profiles of the three brothers. The prediction was that the 16PF profile of HM would differ from the profiles of HT1 and HT2. This was indeed the case for 10 of the 16 personality factors. In contrast to his brothers, HM (represented by the bold line) could be characterized as more intelligent (B+), more affected by feelings (C-), more expedient (G-), more tenderminded (I+), less conventional (M+), more guilt prone (O+),

more open to new experiences (Q₁), more self-sufficient (Q₂), less controlled emotionally (Q₃), and more tense and frustrated (Q₄). On the basis of a scoring system suggested by Krug (1981), HM could be described as moderately extraverted, highly anxious, low in tough-mindedness, moderately independent, and low in self-control. This pattern has often been seen particularly in those who have a mild degree of conflict in interpersonal relationships. This pattern suggested that HM liked to be around people, but found them difficult to accept at face value; and was outgoing, but intimidated by social situations. Low tough-mindedness was also indicative of low masculinity/high femininity. Individuals with HM's profile have scored highest on the 16PF career theme scale of nurturing-altruistic (e.g., physician) and have scored lowest on the mechanical-operative scale (e.g., machine operator).

Table V. Measures of Masculinity–Femininity

Measure	HM	HT1	HT2
<i>Rorschach variables</i>			
<i>M</i> (Human movement)	20	2	1
<i>M</i> % (Femininity)	50	7.69	4.17
<i>B</i> (Barrier)	9	15	20
<i>P</i> (Penetration)	17	6	3
$1 - \frac{ B-P }{B+P} \times 100\%$ (Femininity)	69.23	57.14	26.09
Bem Sex Role Inventory (% feminine items endorsed)	75	50	35
Bem Sex Role Inventory (% masculine items endorsed)	40	60	80
Boys' Gender Conformity Scale (<i>M</i>)	3.51	1.99	1.57
MMPI-2 Masculinity–Femininity (<i>M</i> = 26.01, <i>SD</i> = 5.08)	45	40	28
16PF Sensitivity factor sten score (<i>M</i> = 5, <i>SD</i> = 1)	9	4	5

The profiles of HT1 and HT2, while more similar to each other than to the profile of HM, showed some differences. HT1 could be described as someone who took a practical approach to life, was not very flexible, and was highly dependent, whereas HT2 had a less practical approach to life, was more flexible, but was still highly

dependent. Both HT1 and HT2 were more masculine than HM. Individuals with HT1's and HT2's profiles have scored highest on the 16PF career-theme scales of procedural–systematic (e.g., navy officer) and venturesome–influential (e.g., sales manager), and lowest on nurturing–altruistic (e.g., Cattell et al. 1970). Correlations among the

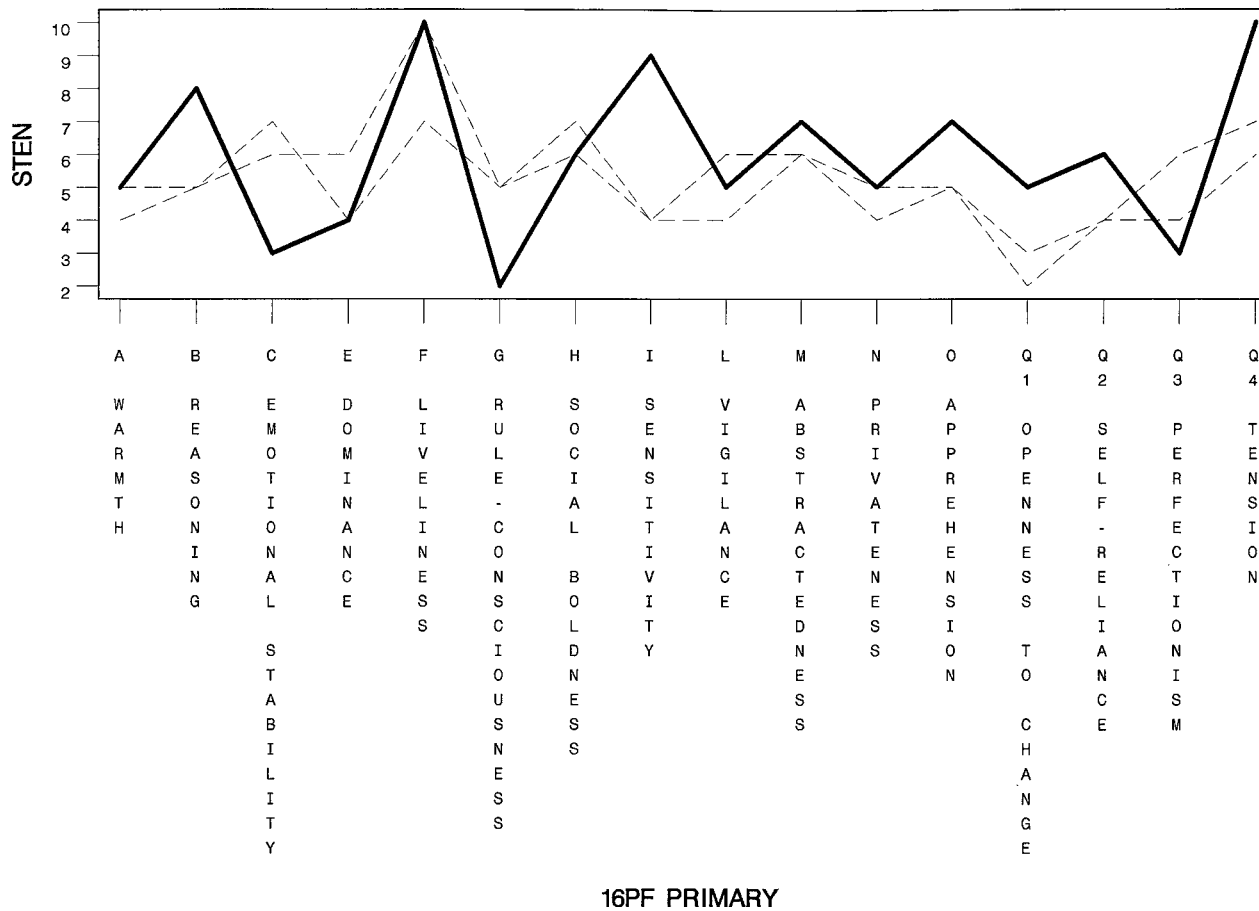


Fig. 1. 16PF profiles of the triplets.

Table VI. Measures of Cognitive Abilities

Measure	HM	HT1	HT2
<i>Rorschach variables</i>			
R (Response productivity)	40	26	24
A (Animal content)	19	17	17
1 - A% (Intellectual functioning)	52.50	34.62	29.17
Water level task (% correct)	42	77	69
Mental rotation (% correct)	35	70	65
Shipley-Hartford Vocabulary Test (% correct)	77.5	72.5	62.5

triplets' 16PF profiles also provided evidence of personality differences between HM and HT1/HT2. The correlations between the profile of HM with the profiles of HT1 and HT2 were $-.27$ and $-.43$, respectively, whereas the correlation between the profiles of HT1 and HT2 was $.48$. To examine whether sexual orientation differences were related to sex differences, two difference scores were computed for each of the 16PF scales: (a) the difference between HM and the average of HT1 and HT2 and (b) the difference between males and females from the normative sample results reported by Cattell et al. (1970, p. 70). The correlation between sexual orientation differences and sex differences across the 16PF scales was $.35$.

Table VI provides the results of several cognitive ability measures. These results are in line with our predictions: On the water level and mental rotation tasks, HM did least well; on the vocabulary test (analogous to the negligible difference found between men and women), the triplets did not differ greatly. Interestingly, the Rorschach variables indicated that HM was more intelligent than were his two brothers, or at the very least, more creative.

To compare the cognitive ability profiles of the triplets, multidimensional scaling was used to construct a set of coordinates for each of the 23 ETS factors of cognitive ability. Determined by coordinate values, the ordering of the triplets on a dimension indicated how similar the triplets were to each other on the cognitive ability factor. From these coordinates, distances were computed between each of the triplets. Our hypothesis was that the distance between HM and both HT1 and HT2 would be greater than the distance between HT1 and HT2. The similarity coefficients in the association matrix used for the scaling were computed by taking the ratio of each triplet's performance to each of the other triplets' performance, resulting in six similarity coefficients for each cognitive ability. These six coefficients were placed into an asymmetric 3×3 association matrix, with the three brothers defining the rows and columns of the matrix. Zeros were placed in the main diagonal of the matrix, indicating that a triplet was not to be compared to himself.

Table VII details the results of the multidimensional scaling. Visual inspection of the table indicated that HM lies further away from HT1 and HT2 than HT1 and HT2 did from each other. This was confirmed by the average computed for each of the distances: The two average distances between HM and his two brothers were significantly greater than the distance between HT1 and HT2.

To further emphasize the differences between the cognitive ability profiles of the homosexual and heterosexual triplets, Fig. 2(a) and (b) graph the three profiles together, with the bold line representing HM's performance and the dashed lines, HT1's and HT2's performance. The differences between the homosexual and heterosexual profiles were striking: the correlations between the profile of HM with the profiles of HT1 and HT2 were $-.90$ and $-.89$, respectively, whereas the correlation between the profiles of HT1 and HT2 was $.60$. To examine whether sexual orientation differences were related to sex differences, two difference scores were computed for 11 of the 23 cognitive ability factors: (a) the difference between HM and the average of HT1 and HT2 and (b) the difference between males and females from the normative sample results reported by Ekstrom et al. (1976, pp. 11-15). (Ekstrom et al. only reported normative data by sex for 11 of the cognitive ability factors.) The correlation between sexual orientation differences and sex differences across the 11 cognitive abilities was $.43$.

DISCUSSION

The bases of sexual orientation have been explained with reference to multiple explanations, variously emphasizing genetic, biological, and experiential effects, as indicated above. It is impossible to determine the precise blend of causal factors eventuating in discordant sexual preferences among this MZ male triplet set. The finding that HM (but not his two brothers) showed signs of gender nonconformity as a child was consistent with previous findings in the twin literature.

Table VII. Coordinates and Distances Between the Triplets for the 23 Cognitive Ability Factors of the ETS Kit of Factor-Referenced Cognitive Tests

Factor	Coordinates			Distances		
	HM	HT1	HT2	HM-HT1	HM-HT2	HT1-HT2
Flexibility of closure	-1.35	1.05	0.35	2.40	1.70	.70
Speed of closure	1.38	-.41	-.97	1.79	2.35	.56
Verbal closure	1.23	-1.22	-.01	2.45	1.24	1.21
Associative fluency	1.38	-.43	-.95	1.81	2.33	.52
Expressional fluency	1.22	-1.22	.00	2.44	1.49	1.49
Figural fluency	1.41	-.67	-.74	2.08	2.15	.03
Ideational fluency	-1.39	.49	.90	1.88	5.24	.41
Word fluency	1.39	-.49	-.90	1.88	5.24	.41
Associative memory	1.39	-.49	-.90	1.88	5.24	.41
Memory span	1.32	1.10	.21	.22	1.11	.89
Visual memory	-1.41	.71	.71	2.12	2.12	.00
Figural flexibility	-1.35	.31	1.04	1.66	2.39	.73
Flexibility of use	1.31	-.21	-1.11	1.52	2.42	.90
Induction	-1.26	.08	1.18	1.34	2.44	1.10
Integrative processes	1.41	-.71	-.71	2.12	2.12	.00
Number	-1.33	.24	1.09	1.57	2.42	.85
Perceptual speed	1.41	-.62	-.79	2.03	2.20	.17
General reasoning	1.22	.01	-1.23	1.21	2.45	1.24
Logical reasoning	-.09	-1.18	1.27	1.09	1.36	2.45
Spatial orientation	-1.25	.90	.35	2.15	1.60	.55
Spatial scanning	-1.22	.61	.61	1.83	1.83	.00
Visualization	1.10	-.22	-.88	1.32	1.98	.66
Verbal comprehension	1.29	-.14	-1.15	1.43	2.44	1.01
			$\bar{D}^2$	1.75	2.43	.71
			S_D	.51	1.19	.57

Specifically, gender nonconformity has been reported by both cotwins in male and female MZ twin pairs concordant for homosexuality, but only by homosexual cotwins in discordant pairs (Bailey & Pillard, 1993). The fact that this behavior appeared quite early in HM suggests either prenatal hormonal differences among the triplets and/or a genetic predisposition environmentally triggered in only one cotriplet as possible explanations.

While predictable from a neurohormonal theory of sexual orientation, the dramatic difference between the cognitive profiles of the homosexual and heterosexual cotriplets was still surprising, given the triplets' genetic identity. Because significant genetic effects have been found for most cognitive abilities (Sternberg & Kaufman, 1998) and for sexual orientation (Bailey & Pillard, 1995), cotwins and cotriplets are generally very similar in sexual behavior and cognitive ability. If one accepts that sexual orientation explains some of the cognitive ability differences between cotwins and cotriplets, then what explains sexual orientation differences between them? Genes are not the sole influence on the development of sexual orientation, and it might well be that differences in androgenic exposure prenatally are attributable to unique intrauterine conditions not under genetic control

for prehomosexual cotwins or cotriplets. In fact, in some respects, twins and triplets, especially MZ, are subject to prenatal environmental effects that differ from those of their cotwins or cotriplets, the most well known of which is birth weight (Martin & Hershberger, 2001). It is not at all unusual to observe greater differences in birth weight between MZ than DZ twins.

Various theories have been proposed to explain how siblings occupying the same womb, either simultaneously or sequentially, might be exposed to different prenatal androgenic patterns. One theory proposed that the twin sisters of twin brothers or the twin brothers of twin sisters are exposed to the androgenization pattern of the opposite sex (Miller, 1994); the evidence for this theory in humans is tenuous at best, although strong in nonhuman animals (Rose et al., 2002). A theory similar to the opposite-sex hormonal exposure theory has concerned the possible variations in hormonal exposure that accompany different intrauterine positions (Ryan & Vandenberg, 2002). Again, the evidence for the validity of this theory in humans has been questionable. In nonhuman animals, however, Clark, Vonk, and Galef (1997) have found intrauterine position to be associated with a number of sexually dimorphic characteristics: postnatal responsiveness

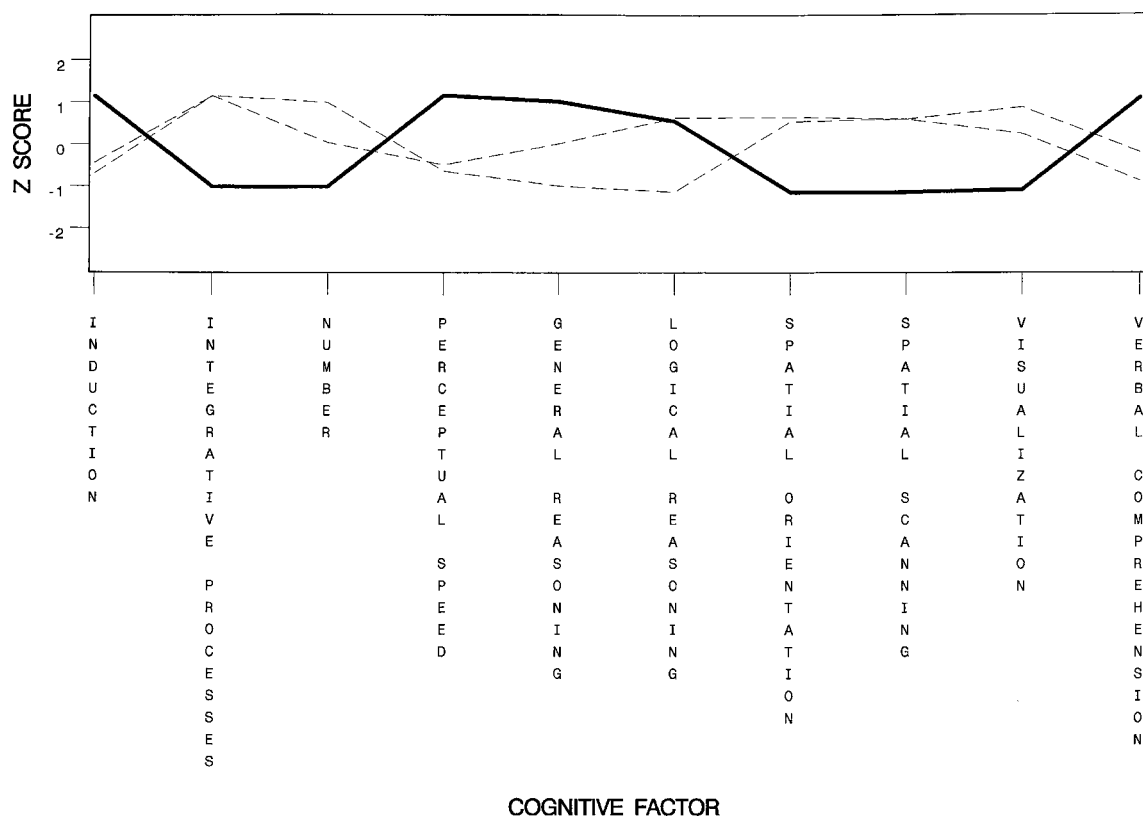
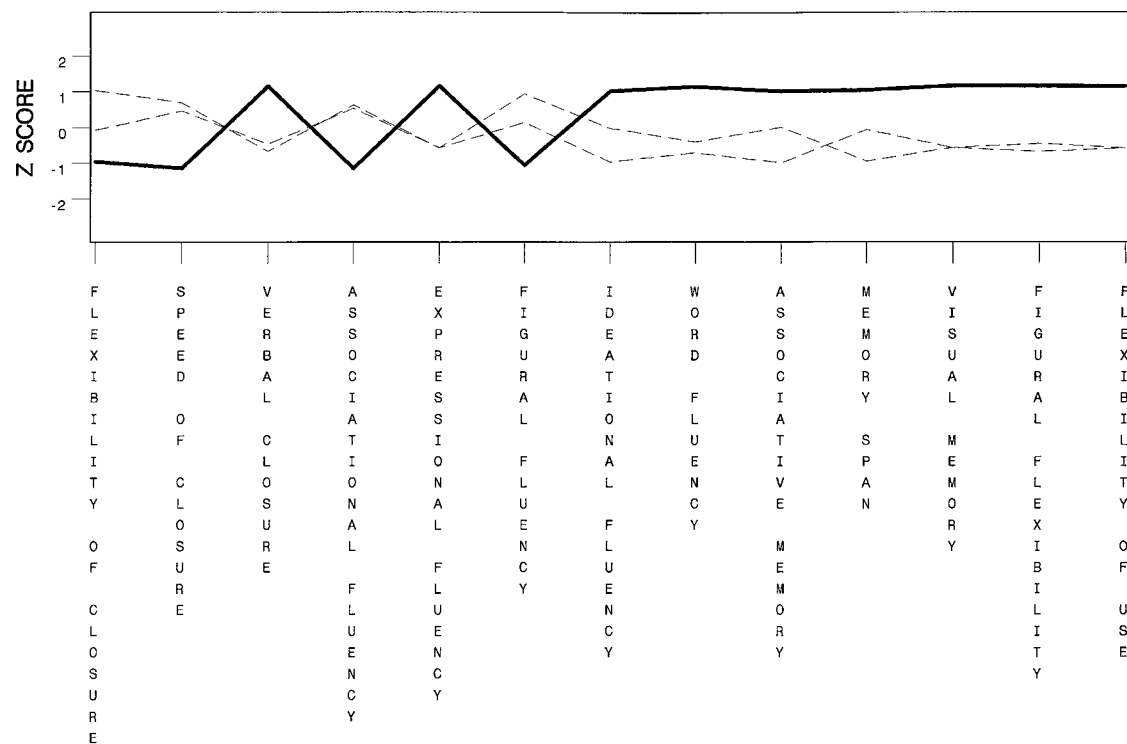


Fig. 2. Cognitive ability profiles of the triplets.

to and levels of testosterone, fertility, sexual virility, sexual position, paw preference, social dominance, and muscle size. For human singletons, strong evidence exists that a late fraternal birth order in men is associated with homosexual orientation (Blanchard & Bogaert, 1996). It has been hypothesized that this fraternal birth order effect results from the progressive immunization of some mothers to Y-linked minor histocompatibility antigens (H-Y antigens) by each succeeding male fetus, and its subsequent effect on the future sexual orientation of each succeeding male fetus (Blanchard, 2001).

Another explanation for sexual orientation differences could lie in the timing of zygotic splitting.⁴ MZ twins result when a single fertilized zygote divides between the 1st and 14th days after conception (Bryan, 1992). If, during this period of time, one of the halves of the zygote itself splits, MZ triplets result. Thus, it is possible for several days to pass before the second splitting occurs. Given that the results were generally ordered as HM, HT1, HT2, we can speculate that HM and HT1 resulted from the first zygotic split, and HT1 split to create HT2. This time lapse between the first and second splitting might place HM on a developmental course different from the other two triplets. One way in which the developmental course may differ for HM is described by developmental instability theory (Gangestad, Bennett, & Thornhill, 2001). Developmental instability theory suggests that homosexuality might be due to general developmental disruption, which produces a shift from the developmental trajectory of sexual orientation from the typical heterosexual preference (Lalumière et al., 2000). These “developmental disruptions” (e.g., chromosome mutations), experienced by HM alone, are offered as an alternative to exposure to atypical hormone patterns as an explanation of homosexuality.

The placental status of the triplets may also create developmental differences between one triplet and the other two. Under our scenario, HM and HT1, because they resulted from early zygotic splitting, will likely have separate placentas (giving the appearance of one). It is very rare for triplets to share a placenta (Luke & Eberlein, 1999). On the other hand, the later zygotic split that hypothetically produced HT2 from HT1 may have resulted in a fused placenta, especially if the split occurred towards the end of the 14-day period following conception (Bryan, 1992). Late splitting is associated with opposite-handedness and we know that HT1 is left-handed. The separate or fused status of twins’ placentas has been found to be related to twin concordance or discordance for some traits (e.g., schizophrenia: see James, Phelps, & Bracha,

1995; personality: see Sokol et al., 1995). Therefore, the sexual orientation difference among the triplets may have arisen from the status of their placenta. Unfortunately, the placental characteristics of HM, HT1, and HT2 cannot be reliably determined. Speculation suggests that developmental disruption from zygotes splitting and/or maternal immunization to H-Y antigens (from having delivered a male child, then three triplets) affecting HM could be contributing factors. HM was the lightest at birth, although he differed by 2 oz from HT2.

Although genes or hormones or both play a substantial role in the development of sexual orientation, the correlation between genes and nonshared environments are important, as well (e.g., Kendler, Thornton, Gilman, & Kessler, 2000). Nonshared environments are environmental experiences unique to an individual. Genotype-environment correlation (CovGE) refers to a correlation between the genetic and environmental influences affecting a trait. As in any other correlation, where certain values of one variable tend to occur in concert with certain values of another variable, a significant CovGE represents the nonrandom distribution of the values of one variable (genotype) across the values of another variable (environment). CovGE may be consequential for sexual orientation development, because when CovGE is present, we would expect different phenotypes to be selectively exposed to environmental experiences based upon their differing genetic propensities.

One area in which CovGE is likely to be of importance is the behavior of parents towards their children. Although the triplets asserted that they were equally and fairly treated by their parents, it is likely that, given their differing behavioral styles and corresponding nicknames, their mother and father did not treat them exactly alike, but modified their parenting practices in response to the behaviors expressed by each of their three sons. A substantial body of studies supports the view that parents respond to, rather than create, behavioral differences among twins and siblings. This would be a form of “reactive” genotype-environment covariance (Reiss, Neiderhiser, Hetherington, & Plomin, 2000). Even if parents tended to treat MZ twins alike or different, this would probably be of little consequence for the development of sexual orientation. A substantial body of research has suggested that, in general, treating MZ twins alike or different has not been related to behavioral similarities and differences (Loehlin & Nichols, 1978; see also Segal, 2000). Research specific to the relation between differences in parental treatment and sexual orientation has been focused largely on the “rejecting father” theory of sexual orientation development, whereby fathers have been closer and warmer towards their future

⁴This idea was suggested by a reviewer.

heterosexual male children than their future homosexual male children, who were kept at an emotional and physical distance (Ellis, 1996).

One interesting measurement issued suggested by this study, and in others that attempt to measure both sexual orientation and masculinity–femininity, was the construct distinctiveness of sexual orientation and masculinity–femininity scales. Recall that HT1, who reported that he found the idea of having sex with other men desirable, had an MMPI-2 masculinity–femininity score very similar to HM's score. Lack of construct distinctiveness was especially likely when the two scales have been created from subsets of items from some larger, more general scale: Because both the masculinity–femininity scale and the HSX (homosexuality scale) were derived from items from MMPI-2. HSX scale may simply have been another measure of masculinity–femininity.

Several observations about the scales' items suggest that HSX may, in part, have been a measure of masculinity–femininity. First, the two scales share five items in common: liking the work of a librarian, collecting flowers or growing houseplants, indulging in unusual sex practices, frequently worrying, and liking the work of a building contractor. Furthermore, each of these five items was scored in the same masculine–feminine direction on both scales. For instance, a "true" response to liking the work of a librarian was scored in a feminine direction on both HSX and MMPI masculinity–femininity scales. In addition, although five items may not have appeared to be a large number to have in common, considering that the masculinity–femininity scale consisted of 56 items ($5/56 = 8.93\%$), when looked at in terms of the 17 items on HSX, it was substantial: five items were 29.41% of the total number of items on HSX. On the other hand, the fact that the HSX scale does not contain many of the "obvious" occupation and hobby/interests items that are in the MMPI-2 masculinity–femininity scale (and which are found on most measures of masculinity–femininity) supports the construct distinctiveness of the two scales: for example, in addition to asking about liking the work of a librarian or a building contractor, the masculinity–femininity scale has items asking about liking to be a singer or a florist. Altogether, the masculinity–femininity scale has 11 occupation and 7 hobby/interests items. In addition, if the HSX scale were simply another measure of masculinity–femininity, one would expect that of all the masculinity–femininity items, item 62 of MMPI-2, "I have often wished I were a girl," would have distinguished homosexual from heterosexual males in Panton's (1960) original study. Given the difficulty in distinguishing the meaning of responses to sexual orientation scales from masculinity–femininity scales, studies should, as in the

present one, use several measures of each. If only a single measure of each construct is possible, then at the very least, the two measures should not have items in common; that is, they should not be derived from the same scale.

In summary, this study has shown that MZ cotriplets, despite their genetic identity, manifested substantial differences in sexual orientation, cognition, personality, and gender conformity. The common source of these interrelated differences was thought to be attributable to differences in prenatal androgen exposure. Further insight into the origins of sexual orientation could be obtained if the *how* and *why* of differences in prenatal androgenization between MZ twins or triplets become the focus of intense study.

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